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PLANT PROTECTION OVERSEAS REVIEW

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PLANT PROTECTION OVERSEAS REVIEW

A PERIODICAL SURVEY OF NEW DEVELOPMENTS IN THE CONTROL OF PESTS, DISEASES AND WEEDS

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INTRODUCTION

" Plant Protection Overseas Review" comes to you from the Export Department of Plant Protection Ltd. It will be issued at suitable intervals for circulation to all our overseas companies and agents in order that they, and the various agricultural organisations with which they co-operate, may be kept in touch with plant protection problems in territories other than their own.

The subject matter of the Review falls roughly into three categories :

(1) Articles on fundamental problems, for example " The Locust Problem" in this issue.

(2) Accounts describing the practical experience of overseas agriculturists in applying modern methods of pest control, for example the article by Mr. Y. K. K. Talvitie in this issue.

(3) Brief items of current information on all plant protection matters gleaned from published literature as well as internal sources. This section of the Review will appear regularly under the title of " Technical Brevities."

In addition, reference will be found to the literature published by the Company for use in overseas countries. Although different in style and emphasis, these publications serve the purpose of disseminating reliable information on insecticides, fungicides and allied products which it is our aim to foster in " Plant Protection Overseas Review."

THE LOCUST PROBLEM

PART 1 — AN INTRODUCTORY SURVEY

By O. B. LEAN

In countries subject to the ravages of the locust the importance of control needs no stressing, and in this preliminary article Mr. O. B. Lean outlines the problem confronting investigators. Two important morals emerge from this survey: (1) *Effective control is impossible without a detailed biological study of the habits of locusts and their environment.* (2) *Control methods, even though they are based on the soundest scientific evidence, may be set at nought without international co-operation between all territories where the locust breeds or swarms.*

Future papers contributed by Mr. O. B. Lean will contain specific advice on control measures and detailed accounts of the individual species of locusts.

INTRODUCTION

THROUGHOUT the field of applied entomology there is nothing quite comparable to locust control. Some other pests may inflict as much damage; many are characterised by a similar, though usually less pronounced, periodicity; others exhibit the migratory habit; no other insect pest combines these three characteristics to the same degree as the various locust species and it is these characteristics that have established the locust in popular imagination as the foremost insect pest of the world.

In order to achieve control of any pest we must know its intimate biology and this entails not only familiarity with the straightforward life history but full appreciation of the habits of the pest and its relationship to its environment. Without such knowledge the control of locusts would become a hopeless task and it is only since research workers in many parts of the world have studied the locust as a living organism, influenced by its environment, that real progress has been made. This dates the establishment of modern locust control to 1921 when Uvarov first propounded his fundamental phase theory. Progress in the control of any pest follows the development of insecticides and other direct control measures alongside biological research into the behaviour of the pest. The two must proceed together and no insecticide, however potent, can achieve economic

control if it be applied blindly and in ignorance of the whole complex that has created a pest out of a harmless insect.

Most insect and fungus diseases of agriculture attain epidemic proportions by the disturbance of natural vegetation, by the unnatural concentration of crops and by the introduction of plants into unsuitable climates. Such factors, and of course there are others, tip the scales of the balance of nature and create a new pest. It is doubtful if most locusts became pests through man's interference with nature. The periodical transformation from a harmless grasshopper is more impelled by climatic fluctuations reacting upon natural environments. As these fluctuations presumably occurred before man tilled the world's soil the locust is probably one of the oldest enemies of mankind, older even than civilisation itself. On ancient monuments and in the Bible there is ample evidence of the antiquity of locust plagues and those interested in the first and most vivid account of the locust should read the Book of Joel: "*Like the noise of chariots on the tops of the mountains do they leap, like the noise of a flame of fire that devoureth the stubble, as a strong people set in battle array.*"

GRASSHOPPERS AND LOCUSTS

The locust is a grasshopper that has developed strong gregarious and migratory habits which lead the immature stages to march in massed hopper bands and the adults to migrate great distances in dense swarms. Most grasshopper species never even approach the swarming phase but an increasing number go, as it were, half way towards becoming locusts and as swarming grasshoppers inflict serious damage. It is dangerous to dogmatise but, in contrast with the locust, the grasshopper that remains a grasshopper usually becomes a pest through man's agricultural effort. This has been so in the United States where grasshoppers now cost the country over £10 million per year in loss of crops and in control measures.

Grasshoppers are becoming increasingly serious in Australia and in Africa and some species, not long ago almost museum curiosities, are now major pests. The increasing agricultural development of Central Africa must be expected to favour the development of other species and our attention is likely to be focussed more and more on grasshoppers, though not at the expense of locust control.

Distributed through the tropical and sub-tropical regions of the world there are about eight kinds of true locusts, with several subspecies and geographic races, that invade over 80 countries. Each species has evolved independently those features that make a locust, and their general behaviour has much in common. In the present article attention will be drawn to the more fundamental aspects of locust biology and control, and in subsequent articles it is hoped to give more detailed accounts of the various species and the particular problems that arise in the territories liable to invasion.

THE PHASE THEORY

The phase theory must be the starting point for any study of locust control. All locust species are extremely plastic in their morphological characters and behaviour, and the extreme forms may be so different that they were once regarded as distinct species. At one extreme the individuals of *phase solitaria* behave as solitary grasshoppers, exhibiting little reaction to the presence of their fellows. At the other extreme are the individuals of *phase gregaria*, the true locust. Intermediate, *transiens*, forms may be either *congregans*, that is to say *solitaria* tending towards the swarming phase, or *dissocians*—locusts reverting to the solitary. The phase of a locust community depends primarily upon population density and though *solitaria* can be made to acquire *gregaria* characters by enforced activity, in nature this activity comes through close contact with, and excitation by, other members of a crowded population.

The periodicity of locust plagues is legendary. A country may be entirely free of swarms for perhaps ten years only to be over-run suddenly by a devastating migration. This is not due to a shift in the distribution of the locust infestation. During the long interval the locust phase may be completely absent throughout its area of distribution and the species only persists in limited localities in the solitary phase. Within the normal distribution of the *solitaria* there are yet more defined areas where conditions may arise, normally through climatic fluctuations, to concentrate the individuals to such a degree that phase transformation occurs. Areas where this may happen are known as outbreak areas. These are the sources of locust plagues and, as such, their recognition becomes the first step in any preventative policy.

Two stages mark the development of *phase gregaria*. Firstly, there must be a general multiplication of the species permitted, for example, by exceptionally abundant or prolonged rainfall; secondly, concentration must be enforced. Concentration may result from such external factors as gradual desiccation of vegetation leaving pools of green food where the insects congregate, or by rising floods driving the insect population onto islands, or by incomplete burning. Whatever the external factors responsible, gregarisation is completed by the reactions of the individual insects to local climatic factors. For instance the normal reaction of the individual to bask in the morning sun on the exposed side of vegetation upon which it roosted during the night lead the individuals to associate together. Driven by this and other common stimulations the insects gradually become conditioned to the proximity of their fellows. The population ceases to consist of isolated individuals and becomes an assembly with a common behaviour.

LIFE HISTORY

In comparison with phase transformation the life history of locusts is simple. The adult becomes sexually mature after a period that varies from a month to six months, or even longer, according to the climate. The onset of maturity is normally marked by colour changes —in some species both sexes turn yellow, in others only the males. The female lays a series of packets of 70 to 100 eggs several inches below the surface of the soil, covering the eggs with a frothy excretion. Usually the eggs hatch after two to three weeks. The insect then passes through six hopper stages, the first of which is very brief and not always recognised, during a period of four to seven weeks. After the final moult the insect has fully developed wings and the cycle is repeated. In some locust species a diapause interrupts the cycle. For instance the eggs of the Asiatic Migratory Locust and those of the Moroccan Locust remain dormant through the winter. With other species the diapause is passed in the adult stage. In all cases dormancy is broken by the onset of climatic conditions favourable to normal development.

Temperature and humidity regulate the speed of the developmental cycle and the behaviour of the hoppers and adults is dominated by climatic factors. When the climate of a region is known and when the reactions of the locust are understood, the seasonal sequence of adult migrations and breeding can be foretold. When the responses of hoppers to diurnal changes are learnt, the hourly behaviour of the hoppers can be utilised to apply control measures to the best advantage. Unfortunately the climate is extremely variable in many areas frequented by locusts and though we may forecast the general trend of a locust plague the precise extent and direction of the migration and the time when breeding will commence is never certain.

MIGRATION OF LOCUSTS

The migrations of locusts are not haphazard but are directed by the climate. Locusts cannot tolerate a climate too wet or too dry, excessively hot or cold, and as the seasons change the swarm is carried by the climatic current enabling the locusts, unless held up in some backwater, or carried far out by abnormal winds, to persist in a favourable environment.

The different locust species inhabit different climatic belts. This is clearly shown in Africa. Of the three major species, the Desert Locust ranges over relatively arid country, as its name implies, but even it avoids extreme desert. Its area of distribution extends from Senegal and Morocco in West Africa to central India, and from Turkey and the southern Republics of U.S.S.R., through Arabia to Tanganyika. The African Migratory Locust occupies a more humid belt that overlaps that of the Desert Locust but which is generally south of it, following closely the great area of intermediate vegetation between the desert and tropical forest. The Red Locust spreads through

an even more humid zone in central Africa. All species avoid the equatorial belt where the seasons are less clearly demarcated, and regions of tropical climate with extreme wet and dry seasons are typical locust areas. Here any less mobile insect must remain dormant to withstand long periods of adverse climate, but the locust can migrate from areas of summer rainfall to areas of winter rains and is thus enabled to pass at least two and sometimes three generations per year.

The migrations carry swarms over great distances. A swarm may fly a hundred miles or more in a day but an average of thirty miles is more usual. Even this, when continued for several months, means that a single swarm may fly out of one country and traverse several others before breeding and, furthermore, that the locust infestation throughout the whole infected belt is interrelated. When control measures are designed solely to defend crops they can be planned territorially; if they aim at prevention all countries must work together on a common plan designed where possible to prevent swarm formation at source. Unfortunately our information on outbreak areas is still incomplete and it will take a period of years of intensive research to define all danger spots before we can contemplate complete prevention. Meanwhile the locusts will continue to swarm and concerted international campaigns must be waged at an early stage during the plague and, where possible, long before the swarms penetrate the richer agricultural lands.

Outbreak areas of the Desert Locust are known to exist on the Mekran and Red Sea coasts and it is to the obvious interest of, for example, Russian Turkestan, Syria and Kenya, far from these sources, to play some part in the preventative work. Widespread secondary breeding may occur in Saudi Arabia or the Yemen, countries which have few crops to lose and which cannot afford the high cost of an anti-locust campaign for the benefit of their neighbours. Dense hopper bands marching down the tracks of the Argentine railways cause serious traffic dislocation, and when we know more about the South American locust it may be found that it is far better to control the locusts in Bolivia than to wait for them to migrate into Argentina. How best to achieve the required international approach is at the present time the particular concern of the locust entomologists.

CONTROL METHODS

Poison baiting is recognised as the standard method of locust control. Sodium arsenite or sodium silicofluoride were, until recently, the normal poison ingredients of bait. Now benzene hexachloride is accepted as the best insecticide for this purpose and it can also be applied, though less economically, as a contact dust or spray. The application of insecticides in the field is not quite so simple as it might appear and the best results can only be achieved by those with hard won experience of locust behaviour. The locust baiter should be able to appreciate the reactions of hoppers to external stimuli and thus anticipate each move so that he expends his ammunition wisely.

The field gang scattering poison bait somewhere out in the wilds forms the spearhead of the attack. Modern anti-locust campaigns are often undertaken in difficult and sometimes perilous country. Scouts and baiters may remain for months in the central Arabian deserts, in the Danakil country of Ethiopia or in the Chaco and they have to be supported by a large organisation responsible for co-ordinating their efforts and in maintaining supplies and transport. Administrative difficulties are often greater than the technical problems of locust destruction. The cost of the insecticide may not exceed one tenth the total cost of the campaign ; wages and especially transport are the major charges. When it comes to international action, political difficulties outweigh even administrative worries.

Locust control was stimulated by the war because a plague of the Desert Locust threatened food production in India, the Middle East and in Africa. Great strides were made in understanding the locust, in organising campaigns on an unprecedented scale and in developing new modes of attack. The discovery of the insecticidal properties of benzene hexachloride and its application against locusts was an important factor in winning the struggle. As we write the Desert Locust remains active in north west Africa but in its north eastern zone, from East Africa to India, the present plague appears to be dying down. Unfortunately both the African Migratory Locust and the Red Locust have started to swarm and have already escaped from their outbreak areas. With the present state of world food production this is ominous news and as the South American Locust is at the peak of its activity the next few years are likely to witness still greater efforts to conquer the ancient enemy.

SOME PLANT PROTECTION PROBLEMS IN SUGAR CANE

PART 1

By N. WRIGHT

Summary

The following account forms the first part of an article on the pests and diseases of sugar cane which, it is hoped, may be the forerunner of a series dealing specifically with the problems of chemical control in relation to individual crops.

Part I, after a general introduction covering the historical development of pest and disease control in sugar cane, discusses the application of 'Gammexane' ('Agrocide' products) to cane pests and gives details of the methods now in commercial use against the sugar cane froghopper (Tomaspis spp.) in the Caribbean area. The application of 20 lb. of Agrocide 3 (5% BHC) per acre by means of drift dusting 3—4 times during the growing season, depending on froghopper incidence, has proved an effective control measure against the adult froghopper. More recent experimental work suggests that this pest may also be controlled in the egg stage by the use of Agrocide 2 (3.5% BHC) as a soil insecticide during the dry weather.

INTRODUCTION

THE wide distribution of the sugar cane crop throughout the world makes any generalized treatment of pests and diseases a matter of some difficulty, and even though many of the major ills of cane are common to a number of countries, the widely differing ecological conditions must be taken into account when considering control measures.

A tropical plant, requiring high temperatures and plenty of water for maturation, sugar cane is also grown extensively outside the tropical region, notably in Northern India, Natal, Egypt, Louisiana and the Argentine. This extension of the cultivated area beyond the natural limits of the crop has been made possible largely by the breeding of new varieties.

In 1884 world production of sugar cane was some 2½ million tons; in 1938-39 it was 17½ million tons. This great expansion of the industry was greatly accelerated by the discovery in 1888 of a technique for effecting cross-pollination. Since then vast numbers of new seedling canes have been raised at specially equipped breeding stations in Java, India, Barbados, British Guiana, Mauritius and other centres with the main object of securing types which combine the high sucrose content of the thick (Noble) canes with the disease resistance of the thin canes. In fact, the need to obtain canes resistant to such diseases as *sereh* (in Java), root disease (in the West Indies) and mosaic (in S. Africa, U.S.A. and elsewhere) provided the chief stimulus to breeding work in most of the cane-breeding countries. Against some pests, too, breeding has played an important part in reducing losses, for example in Hawaii where the use of a hard cane H.109 has helped to minimise the damage caused by the borer (*Rhabdocnemia obscura*).

It is impossible to discuss pest control in sugar cane without referring to the significant results sometimes obtained by the introduction of insect parasites. The moth borer (*Diatraea saccharalis*)—the most serious sugar cane pest in the U.S.A. and parts of Central America and the West Indies—illustrates the fact that in spite of intensive methods of mass breeding and release of parasites, the control obtained may be only partially effective or not effective at all if ecological conditions are unsuitable. The mass liberation of the wasp—*Trichogramma minutum*—an egg parasite known to be effective in parts of the West Indies—was found in Louisiana to have a comparatively small effect on borer losses even though the parasite appeared to thrive and multiply. Similarly, the introduction of the tachinid parasite—*Lixophaga diatraeae*—which successfully controls borers in Cuba, Jamaica, Antigua, etc.—met with very little success in most parts of the U.S.A. where borer damage has been estimated (1938) to amount to 6 million dollars annually. Recently reports [1,2] have been published in the U.S.A. of successful borer control using benzene hexachloride as the insecticide. If this method can be developed on an economic scale a great step forward in cane pest control will have been made.

There is obviously big scope here for more efficient control methods—cultural and chemical. Biological control is a long-term measure of whose final success there can be no guarantee; meantime heavy losses may continue, and chemical means should be closely investigated before research into biological methods—often occupying several years—is embarked upon.

It is perhaps fitting at this point to sound a warning note as to the possible consequences of chemical control—especially by the method of drift dusting—in areas where natural or introduced parasites are effectively controlling another pest. Observations are necessary to ensure that the parasite is not so reduced by the insecticide that the pest it controls is allowed to assume economic importance.

Economic considerations, particularly competition from the sugar beet industry, coupled with rising labour costs, are responsible for the increasing mechanization which can be witnessed today in many

cane-growing countries. Wherever cane sugar is an important export commodity, growing costs must be most carefully watched, and for this reason increasing attention paid to large scale, economic pest and weed control, using such machines as the Buffalo Turbine sprayer/duster. Even in countries like India where cane is still predominantly a peasant crop grown for local consumption, the use of power spraying machinery cannot be ignored ; here the unit to be considered is not the individual holding but scores of adjoining properties and in such circumstances pest control becomes the concern of provincial or federal authorities.

SCOPE FOR THE USE OF AGROCIDE ('GAMMEXANE') PRODUCTS

The gamma isomer of benzene hexachloride has been proved to be toxic to a very large number of insects of widely different types. Its successful use against locusts, soil pests such as the white grub of sugar cane and also against the froghopper blight—to mention a few which concern us in this article—serve as excellent illustrations of the fact that ' Gammexane ' gamma B H C is outstanding amongst insecticides not only because it can replace arsenicals and derris products, but by virtue of its fumigant properties coupled with its action as a stomach and contact poison. It thus has uses in entirely new fields of application, notably that of a soil insecticide. The range of 'Agrocide' insecticides is based on ' Gammexane ' gamma B H C and a number of formulations are marketed by Plant Protection Ltd. for specific agricultural purposes.

THE SUGAR CANE FROGHOPPER

(*Homoptera-Cercopidae*)

This pest of sugar cane has assumed the greatest economic importance in Trinidad, B.W.I., where it has been recognised as a serious menace to cane cultivation since 1889. The species responsible in that island is *Tomaspis saccharina Dist.* Other species of *Tomaspis* are, however, at least potential dangers to the cane farmer as witness the sudden, isolated outbreak on a single plantation in British Guiana in recent years. The species concerned here is *T. flavilatera Ur.* Other species of *Tomaspis* recorded as pests of sugar cane include *T. liturata* var. *ruforivulata Stal.*—the red froghopper or "caminha" of Brazil and *T. bodkini* and *T. postica* in Venezuela.

Life History. Structurally and in their life-history these different species of *Tomaspis* appear to be very similar, and *T. saccharina*, which has been the subject of intensive study since the beginning of the century, may be regarded as typical of the others for the purpose of this account. The female froghopper lays her eggs on the surface of the soil and occasionally on damp trash in the vicinity of the cane stool. Normally the incubation period is between 14-21 days but in Trinidad the eggs may pass through the dry season in a

resting condition with the result that when the rains come very large numbers of eggs from successive broods of the previous season hatch at the same time and cause a severe outbreak of " blight." The absence of this aestivation period in British Guiana probably explains why *T. flavilatera* has so seldom been such a dangerous menace in that country.

After emergence the nymph begins feeding on the fine rootlets at the base of the stools and in so doing extrudes and is finally surrounded by a sticky spittle mass. In this condition the nymph passes through four instars and after the fourth month—some 33 days from hatching—emerges as the adult froghopper. It is the adult insects—at least in Trinidad and British Guiana—which do greatest damage to the cane and cause the symptoms generally associated with " blight." In Brazil, however, observers state that the nymphs of the red froghopper are the most destructive, injecting a toxin into the tissues of the cane plant whilst feeding.

The adults feed on the aerial parts of the cane plant, the puncture marks produced by their stylets developing into long brown (*T. saccharina*) or yellow (*T. flavilatera*) streaks on the leaves. Severely attacked leaves finally drop off and young shoots defoliated in this way, die back, often accompanied by atrophy of the roots. Not only is the yield of cane seriously reduced by froghopper attack, but the quality of the juice suffers, being lower in purity and more difficult to extract.

Control. In Trinidad, severe blight occurs 2-3 times in every decade and is the cause of heavy financial losses to the sugar industry. The improvement of cultural conditions—particularly by liming—has helped to reduce losses from comparatively mild attacks by assisting the recovery of the cane plant but has failed completely to affect either the incidence or the severity of bad outbreaks. Methods of biological control have also been investigated in great detail but success along these lines is now considered very unlikely. There are, it seems, good reasons for believing that cane varieties might in time be found which are more resistant to attack than those now cultivated, but this is a long term project the outcome of which cannot be predicted with any certainty.

Insecticidal control is the only hopeful solution to the problem at present and the new synthetic products are by their potency and reliability rapidly changing the outlook into one of far greater optimism. In the past a considerable measure of control has been obtained by combining an attack on the nymphs with a calcium cyanide dust, applied by hand dusters directly on the spittle masses, with drift-dusting using pyrethrum dust to control the adult froghoppers. This procedure, whilst successful on one Trinidad estate, did not prove a practical proposition elsewhere and its failure was largely attributed to the variable toxicity of the pyrethrum and lack of skill on the part of the operators in timing the applications. Furthermore, where large areas are involved, dusting the nymphs

with calcium cyanide which makes big demands on labour is unprofitable.

It has been shown that the intensity of 2nd and subsequent broods is directly related to the number of 1st brood adults. Thus control methods directed solely against the adult froghopper, as by drift dusting, must aim to coincide with the peak of the 1st brood infestation.

The 1st brood intensity in its turn is determined by the total number of aestivating, viable eggs in the soil carried over from 2nd, 3rd and 4th broods of the previous year. Destruction of eggs or nymphs by means of a soil insecticide would be the ideal method of preventing blight but at present no practical, large-scale measure has been devised for this purpose. There are, however, good grounds for hope that 'Agrocide' 2 may prove an effective answer to this problem. In a small field experiment in Trinidad, 'Agrocide' 2 applied at 8 cwts. per acre reduced the subsequent nymph population by 65% as compared with untreated plots. This work is now being actively pursued in the hope of finding an economic method of control on a commercial scale.

Drift Dusting With 'Agrocide' 3. Field trials in both Trinidad and British Guiana have established that under proper supervision drift dusting with 'Agrocide' 3 may result in a mortality of over 90% in adult froghoppers. 'Agrocide' 3 has been specially formulated for drift dusting, being composed of 5% benzene hexachloride (= 0.65% gamma BHC), plus a light filler such as china clay. Success of the operation depends on accurate forecasting of the outbreak and correct timing of the application.

Weather conditions have been shown to exert a marked influence on the severity of an attack. When the dry season (February-May in Trinidad) is wet, i.e. more than 10 ins. over the four-month period—the subsequent froghopper outbreak is mild. This is due partly to the fact that the eggs, instead of going through the normal resting phase, hatch out at intervals and thus spread the attack over a long period; also to the favourable influence of damp conditions on the natural enemies of the froghopper—both insect and fungus.

For efficient timing the training of a reliable "froghopper gang" to make inspections and counts is indispensable. The importance of accurate recording by estates cannot be over-emphasised; there is a strong temptation for those engaged in it to "cook" the results, and some expedient such as having two gangs covering a given area on alternate days as a check on each other may be the answer. Counts of adult froghoppers are best made on a sampling basis, the size of the sample being 40 canes per field of approx. 5 acres. These 40 canes are made up by counting adults on eight canes (from separate stools) selected at random from the four quarters of the field and from mid-field. Daily records taken in this way give a graphical picture of the population trends of a particular brood, and the type of curve produced serves as a guide to the best time for dusting. When the

curve rises steeply to a maximum, dust may safely be applied after the peak has been passed because the earlier emergences will not have had time to mature and oviposit. With a more gradual type of curve, however, timing is more difficult; here dusting should commence before the peak is reached, when the adult population exceeds 12 per stool, and repeated at minimum intervals of six days until the outbreak is under control.

Dr. H. C. James has published detailed recommendations based on his own experiments in British Guiana for the correct use of the drift dusting method with Agrocide 3. As regards the rate of dust application he advises three dosages depending on the peak value of the population curve :—

For peak values below 30 per stool—20 lbs. 'Agrocide' 3 per acre
" " " between 30-50 per stool—30 lbs. 'Agrocide' 3 per acre
" " " above 50 per stool—40 lbs. 'Agrocide' 3 per acre

It should be emphasized that dusting in any season should begin with the first brood. If this first brood is not attacked and oviposition takes place the adult population may build up to a level where economic control becomes impossible. Drift dusting is best carried out by power dusters, such as the Messenger or Craven, drawn by tractor or, as in British Guiana, mounted on punts. Late evening, when light winds and generally calm, rainless conditions usually prevail, is the best time for dusting.

Residual Effect. 'Gammexane' gamma BHC has a comparatively poor residual effect, and 3—4 applications per season may be necessary. It is very doubtful, however, whether a more persistent product would have much advantage owing to two important factors it would have to overcome: (1) Growth of the foliage—thus spreading the dust deposits over a larger leaf area and exposing fresh, unprotected tissue; (2) weather conditions. The froghopper season is at the wettest time of the year and no contact insecticide is likely to remain effective for long under such conditions. The variety of cane grown has also an effect on persistence; those with an upright habit, e.g. B.37161, being much better in this respect than drooping varieties, like B.34104, which allows the dust to fall or be washed off the leaves.

Cost of Control. The cost of this drift dusting method has been estimated to be in the region of $3.00—$3.50 (12/- to 14/-) per acre for each application at the rate of 20 lbs. per acre. Dr. James states—"there is no doubt that drift dusting with 'Gammexane' when efficiently performed is an economic proposition and forms what has long been lacking namely, a major means of froghopper control."

It must, however, be clearly borne in mind that though we now have some most potent weapons with which to control the froghopper, the last word on methods of applying them has still to be said. Seasonal

fluctuations, and the variations in insect population which accompany them, emphasize the need for more accurate forecasting so that the type of outbreak can be predicted and the timing of applications altered accordingly.

REFERENCES

1. **Dugas, A. L. and Concienne, E. G.** Report to Sugar Cane contact Committee March 5th, 1947. Louisiana Agric. Exp. Sta.
2. **Dugas, A. L. and Smith, D. E.** " Summary of Insecticidal tests on Control of Sugar Cane Borer." *Ibid* April 10th, 1946.
3. **Pickles, A.** " A Discussion of Researches on the Sugar-Cane Froghopper." Trop. Agric. xix, 6, 1941.
4. **Pickles, A.** " Field Trials of Insecticides for the control of the Sugar-Cane Froghopper." Trop Agric. xxiii, 1, 1946.
5. **James, H. C.** " Insect Pests of Sugar Cane." Dept. of Agric., British Guiana (illustrated).
6. **James, H. C.** " The Bionomics and Control of *T. flavilatera Ur.* the Demerara Sugar Cane Froghopper." Paper read at B.W.I. Sugar Technologists' Conference, 1946.

Note. The above references are a very short selection of the voluminous literature on the Froghopper pest. In addition to the published literature the writer has also made valuable use of records and comments in correspondence with Mr. K. Potter of Geddes Grant & Co., Trinidad, to whom he makes grateful acknowledgement.

THE POSSIBILITIES OF USING 'AGROCIDE' PRODUCTS IN FINLAND

By YRJÖ K. K. TALVITIE, M. Agric.

The following account has been abridged from the paper read by the author at the recent Congress of European and North African agents held at Fernhurst. In it Mr. Talvitie (of Soren Berner & Co., Helsinki) discusses the principal uses to which 'Agrocides' 1, 2, and 3 are being put in Finland and the experimental work now in progress designed to extend still further the range of pests which they control. We are obliged to Mr. Talvitie for allowing us to publish this interesting account, and we shall be very pleased to receive from other overseas friends similar articles summarizing the development of the 'Agrocide' products in their countries. In this way the Plant Protection Overseas Review may be made to serve the valuable object of providing an authentic survey based on first-hand information from all parts of the world.

ABOUT the middle of 1946 the first consignment of 'Gammexane' products arrived in Finland; first of all they were tried out experimentally and then they were placed on the market. In spite of strong competition, the 'Agrocide' products have a very good name in Finland and are now well-known by farmers and gardeners—especially 'Agrocides' 1 and 3.

'AGROCIDE' 1

'Agrocide' 1 has been specially recommended for controlling flea beetles in Cruciferous crops. In the early summer damage caused by flea beetles may be very serious in Finland. Both in the official trials and in the experiments arranged by Messrs. Sören Berner and Co., 'Agrocide' 1 has proved to be a most effective dusting powder for controlling flea beetles and for other insect pests. Good results have, for instance, been achieved in the control of the following insects :—

Lesser Striped Flea Beetle (*Phyllotreta undulata*) adults
Black Flea Beetle (*Phyllotreta atra*) adults
Mustard Beetle (*Phaedon cochleariae*) adults and larvae
Striped Flea Beetle (*Phyllotreta nemorum*) adults

Turnip Blossom Beetle (*Meligethes aeneus*) adults
Pea Weevil (*Sitones lineatus*) adults
Ground Weevil (*Anthonomus rubi*) adults and larvae (Strawberry Blossom Weevil)
Strawberry Weevil (*Galerucella tenella*) adults
Ants (*Lasius niger*) adults
Diamond Back Moth (*Plutella maculipennis*) adults and larvae

As the result of our observation it would, however, seem that a larger quantity of ' Agrocide ' 1 dust per hectare than of other dusting powders should be used for controlling these pests in order to obtain a really good result. Possibly the fact that ' Agrocide ' 1 does not cause a large cloud of dust, due to its high specific gravity, increases its consumption to some extent. On the other hand, it has the advantage that the wind does not blow much of it away.

Today, the specialists in the Agricultural Experimental Station recommend that ' Agrocide ' 1 should be used in the seedling stage at the rate of 8 to 10 kilos per hectare, and that in the case of some competitive products only 4 to 6 kilos per hectare need be used. It may perhaps seem that these quantities are too small, but we are accustomed in Finland to consuming as little dust as possible when using arsenical powders as stomach poisons. The low prices of agricultural products compel the farmers to use as small a quantity of pest control products as possible.

Both ' Agrocide ' 1 and products containing DDT have the advantage that they can be used by farmers at the very early stage of growth, that is when the plants have scarcely emerged from the ground, so that being contact insecticides they kill the flea beetles before they start to do any damage. In the case of calcium arsenate the right time to use dusts containing this chemical is when the crops are nearly full grown, and then the beetles will already have caused much damage. An interesting question is whether ' Agrocide ' 1 will cause tainting of the crops. I, personally, do not think there is much danger as we normally use it in the early summer.

' AGROCIDE ' 2

We have at present in Finland no effective products against wireworms. In ' Agrocide ' 2, the leading product for this purpose on the market, there are, therefore, great possibilities. Wireworms are a very serious pest in Finland, especially in the cultivation of seeds and potatoes, and it is also to be found in lawns, root vegetables, and in glasshouses. They also become the uninvited guests of early crops.

' Agrocide ' 2 has been observed to be effective in controlling the following pests :

Cabbage flies (*Erioischia brassicae* and *floralis*) larvae, as dust 10 g/m. of rows
Ants (*Lasius niger*) adults, as dust
Leather Jackets (*Tipulidae*) larvae, as dust 30-40 kg/ha.
Wireworms (*Elateridae*) larvae, mixed in soil, 200 kg/ha.

Tests against wireworms have not yet been concluded, but the results from the first observations are very promising. We believe that 100 kilos per hectare will be a sufficient quantity, and our plant protection scientists are arranging large-scale field experiments during this summer (1947).

It is necessary to ascertain as soon as possible whether and to what extent ' Agrocide ' 2 gives a taint to potatoes and other foodstuffs. Some observations we have made cause one to suppose that it does, but if we can use it on potatoes against wireworms its use in Finland will be considerable as this pest causes much damage.

' AGROCIDE ' 3

In Finland we have come to the conclusion that ' Agrocide ' 3 really is a universal insecticide, effective against all kinds of pests. For instance, in orchards we have successfully controlled with ' Agrocide ' 3 :—

Plum Weevil (*Rhynchites cupreus*)
Leaf Weevil (*Phyllobius spp*)
Orgyia antiqua larvae

On raspberries and currants and other bush fruits, the following pests have been controlled :—

Ground Weevil (*Anthonomus rubi*) adults
Raspberry Beetle (*Byturus tomentosus*) adults
Raspberry Flea Beetle (*Glyptina rubi*) adults
Currant Worm (*Nematus ribesii* and *Pristiphora pallipes*)
Gooseberry Moth (*Zophodia convolutella*) larvae

In glasshouses, the most important pests controlled by 'Agrocide' 3 are :—

Greenhouse White Fly (*Trialeurodes vaporariorum*) adults and larvae
Thrips (*Thrips tabaci*) adults and larvae
Oninscus asellus
Greenhouse Locust (*Tachycines asynamorus*)

' Agrocide ' 3 is more effective than ' Agrocide ' 1 against the following cruciferous pests :—

Flea Beetle (*Phyllotreta spp.*) adults
Mustard Beetle (*Phaedon cochleariae*) adults and larvae
Turnip Blossom Weevil (*Meligethes aeneus*) adults
Turnip Seed Weevil (*Ceutorrhynchus rapae*) adults
Cabbage Butterfly (*Pieris brassicae*, *P. rapae* and *P. napi*) larvae
Gamma moth (*Plusia gamma*) larvae
Diamond Back Moth (*Plutella maculipennis*) adults and larvae

Among other pests which we have controlled by means of ' Agrocide ' 3, I should like to mention :—

Pea Thrips (*Kakothrips nobustus*) adults and larvae
Alopecurus Thrips (*Chirothrips hamatus*) adults and larvae
Pea Aphis (*Macrosiphum pisi*) adults

Bean Aphis (*Doralis fabae*) adults
Cabbage Plant Bug (*Eurydema oleraceum*) adults
Ants (*Lasium niger*)
Timothy (*amaurosoma spp.*) adults
Carrot psylla (*Trioza apicalis*) adults and larvae

Also in control of Onion Flies (*Hylemyia antiqua* and *Eumeris spp.*) adults and larvae, Cabbage Flies (*Erioischia brassicae* and *floralis*) and Carrot Fly (*Psila rosae*) 'Agrocide' 3 is expected to prove an important insecticide used at the rate of 1 to 2 grammes per plant, or 5 to 10 grammes per metre of row.

Following further experimental work it is possible that other uses for 'Agrocide' 3 will be found. Its great advantages are its very good dusting quality, its rapid effect against many insect pests—quicker than the corresponding DDT products, and its non-poisonous effect on humans, animals and crops.

OTHER AGROCIDE PRODUCTS

We are at present testing out the effects and qualities of Liquid 'Agrocide' 3 and 'Agrocide' Wettable Powder. It is not yet possible to say anything about these, but we expect much from them, and they seem to be very promising, especially on fruit trees and on bush fruits.

TECHNICAL BREVITIES

In this section of the Review, which will appear regularly in each issue, we give brief technical data, culled from many sources, relating to plant protection problems in their widest sense. Some of the information has been extracted from correspondence and reports received from our overseas representatives to whom we gladly make acknowledgement. Wherever published literature has been the source of information we give the reference so that those interested may obtain further details. We are also indebted to the Heads of Jealotts Hill and Hawthorndale Laboratories (I.C.I.—Central Agricultural Control) for permission to make use of abstracts from literature prepared by their staffs. In spite of its fragmentary nature, we hope these notes may serve the purpose of stimulating interest in fresh developments and encouraging experiments along new and promising lines of investigation.

INSECTICIDES

BHC—Range of Toxicity. Experiments to test the toxicity of BHC to a very wide range of pests are in progress in nearly all countries of the world. Records from whatever source continue to be kept by I.C.I. staff at Hawthorndale and extend to some 500 different pests.

Cucurbits—Phytotoxicity. The red pumpkin beetle (*Anlacophora abdominalis*) has been successfully controlled in India with a 2% BHC dust after 2 days, the residual effect lasting for 1 month. There was, however, severe burning of the leaves and, on the strength of this experience and similar reports from China and Egypt, we must stress the need for caution in using ' Agrocide ' products on cucurbits. This family of plants is known to be susceptible to other chlorinated compounds besides gamma BHC such as DDT and ' toxaphene.' Environmental conditions and dosage rate are clearly important factors in determining phytotoxicity, and we need wider experience before making firm recommendations.

Cacao—Capsid Bug. A small field trial in Malaya on the control of the capsid bug *Helopeltis* demonstrated the complete success of using 'Gammexane' No. 12 smoke generators in spite of heavy infestation. Wider use of 'Gammexane' smokes in the open appears practicable in crops with a heavy canopy, under calm conditions.

Banana—Virus Diseases. The possibility of controlling a virus disease by destroying its insect vector has received encouraging support from the broadcast statement of the Acting Director of Research, Travancore, who recommended 'Gammexane' gamma BHC to control the aphid carrier of "bunchy top" disease in plantains.

Fruit-Fly. The search for a suitable insecticide to control fruit-flies —notably *Ceratitis capitata* (Mediterranean fruit-fly), *Dacus Oleae* (Olive fly) and *Anastrepha ceratitis* (S. America) is being given high priority in several countries. There is no question that 'Gammexane' gamma BHC is toxic to fruit flies. Myburgh in S. Africa, for instance, found that sugar baits containing as little as 0.0025% gamma isomer caused a higher mortality rate than lead arsenate or sodium fluosilicate at concentrations in normal use. Laboratory tests have also shown the possibility of preventing pupation by treating the soil with a 0.2% suspension of a 50% BHC dispersible powder. Existing knowledge of this group of pests has now been summarised and plans have been formulated for a fresh experimental approach to the problem.

Cotton Pests. The evaluation of 'Gammexane' gamma BHC products for the control of cotton pests is being carried out in a number of countries, prominently by the U.S.A., Brazil, Peru, Egypt and Sudan. A full account of development in this field will appear in this Review shortly. Meanwhile, the following isolated points of interest may be cited :—

i. BHC was found to be more toxic than calcium arsenate against boll weevil (*Anthonomus grandis*) and leaf worm (*Alabama argillacea*) in Texas. In Peru calcium arsenate alone was found to burn the cotton leaves and cause an increase in aphid population. 5% BHC effectively controls both leaf worm and aphis but its persistence according to reports from Peruvian sources, is greatly increased by mixing in equal proportions with neutral calcium arsenate.

ii. One of the most striking uses of a combined insecticide is illustrated by the control of boll weevil and boll worm (*Heliothis armigera*) in the U.S.A. by a BHC/DDT dust containing 3% gamma isomer and 5% DDT with sulphur as diluent, applied 4-5 times at 15 lb. per acre.

iii. 'Agrocide' 7, applied by hand dusters at approximately 68 lb. per acre, produced 100% mortality of cotton stainers in 1½ hours in trials carried out in Peru where it is the principal cotton pest.

iv. 'Agrocide' 3 has been successfully used against the cotton flea hopper (*Horcius nobilellus*) in Brazil.

Cereals—Leaf Miner. Experimental work is in progress in Cyprus on the control of the Tineid leaf miner (*Syringopsis=Scythris temperatella*) which attacks cereals. 'Agrocide' 2 broadcast at 2 cwts. per acre immediately after sowing gave 98% control. Equally good results were obtained with 0.4% 'Agrocide' Wettable Powder applied soon after the first attack and again three weeks later.

Maize—Black Beetle. A 2% BHC dust is proving highly satisfactory for the control of Black beetle (*Heteronychus sanctae Helenae*) on maize in Australia and has showed itself superior to either 2% or 10% DDT. The dust is applied by hand in narrow strips at the rate of 1 oz. per 50 in. strip. Thorough hand-impregnation of the insecticide with the soil to $2\frac{1}{2}$ in. depth is necessary to ensure good control.

Wallace, C. R.—S. Aust. Inst. Agric. Sci. 12, 1946.

In South Africa 'Agrocide' 2 at about 100 lbs. per acre is recommended for application at the time of planting for the control of Black Maize beetle.

Ants. i. In Brazil, as in many other tropical and sub-tropical countries, agriculture suffers severe losses from ants, and two workers there—Autuori and Pupo of the Institute of Biology, Sao Paulo—have made a special study of their control over a number of years. The value of 'Gammexane' gamma BHC, both in dust and smoke forms, for ant control is rapidly being exploited and a special article on this subject will appear shortly in this Review.

ii. A 2% BHC dust applied to citrus and mango trees in India was found to kill all ants and its effect persisted for 10 days; a 5% BHC dust persisted for 14 days. No phytotoxic effects were observed though the trees were not in blossom at the time.

Locust Bait in Peru. An interesting development in the use of poison baits for controlling locust hoppers is reported by our representative in Peru. The bait is prepared by mixing 70 kilos rice powder with 1 kilo 'Agrocide' 7 and 3 kilos molasses, moistening to the desired consistency. This is then made into cakes of suitable size and dried until hard. In this form, the bait can be easily transported as well as stored from season to season. Investigations are in progress to determine the persistence of gamma BHC toxicity when stored in this manner.

Wireworm Control. On heavily infested lands under winter wheat and spring oats BHC (13% gamma isomer) broadcast at 6 lb. per acre or combine drilled at 2 lb. per acre reduced the wireworm population and increased grain yields 2- to 5-fold. Good results were also obtained by an 8% gamma seed dressing at 5 oz. per bushel. *Jameson, H. R., Thomas, F. J. D. and Woodward, R. C.—Ann. Appl. Biol.* 34, 346-56, 1947.

Plum Curculio. Where one generation a year is produced, plum curculio (*Conotrachelus nenuphar*) may be controlled by a BHC and wettable sulphur spray containing 6% gamma isomer. Applied at weekly intervals at the rate of 2 lb./100 gall., or at 10-day intervals at the rate of 3 lb./100 gall. over 95% of the curculios were killed. Larvae and eggs only were affected. Application must not be later than 6 weeks before harvest. There was no taint.

Driggen, B. F.—Agric. Chems. 2:47, 1947 (*abstract*).

Rice Hispa. Completely effective control of rice hispa (*Hispa armigera*) has been obtained, in an experiment reported from India, using 35 lbs. per acre of a 5% BHC dust. It is particularly interesting to note that this relatively low dosage was applied successfully both by hand and by a locally made rotary blower.

Synthetic Insecticides in Africa. In a general article published in the "Tanganyika Standard" of Jan. 14th, 1948, Dr. W. F. Jepson (Entomologist to the Department of Agriculture, T.T.) states that the "onslaught on the stalk borers of maize with D.D.T. 2½% dust and on the sugar cane white grub with 1.25% BHC dust is in full swing." The application of the new insecticides to these and other pests such as locusts, thrips, army worms, etc., under African conditions is making big strides but is still mostly in the experimental stage. These new synthetic products are rapidly replacing pyrethrum and the arsenical poisons.

FUNGICIDES

Citrus—Dual Purpose Spray. Experience in Brazil indicates an important future for a combined 'Perenox'—'Albolineum' wash against citrus pests and diseases. The wash used is 0.25% 'Perenox' (.125% Cu) in 1.75% 'Abolineum'; 20—40 litres are used per tree. It appears to be giving all the control required of the many pests and diseases present, chief of which are Black scale (*Saissetia oleae*) and scab (*Gloeosporium fawcettii*). This method has the additional advantage that one spray application will take the place of the two sprayings necessary when Bordeaux mixture is employed.

Tea—Blister Blight. Experiments carried out by Dr. F. R. Tubbs of the Tea Research Institute, Ceylon, have shown that regular, weekly spraying of nurseries and young clearings effectively protects the young bushes against Blister Blight (*Exobasidium vexans*). As little as 1¼ oz. per acre per treatment has been found sufficient in the nurseries. In young clearings, 1 lb. of 'Perenox' (*i.e.*, 40 gallons of spray) per treatment gave good protection. When mature tea has been pruned and is recovering from spraying it is especially prone to blister blight injury, provided humidity is high when the first shoots are unrolling and there is little or no old leaf to aid recovery of the bush. Under these conditions, 2 lb. of 'Perenox' (*i.e.*, 80 gallons of spray) has proved satisfactory.

Spraying of tea which is in regular plucking would probably not be profitable. The greatest value of 'Perenox' lies in its ability to protect the young bushes, or pruned bushes which are forming new wood that will have to bear a crop for 2—3 years before their next pruning. *Tubbs, F. R.—"The Tea Quarterly," July* 1947.

In subsequent, unpublished work it is understood that Dr. Tubbs has found concentrations even lower than 4 oz. per 10 gallons to be effective. This result is of special interest from two points of view: (1) cost of the chemical is reduced, (2) less copper accumulates in the soil and, if current belief in regard to the repeated use of Bordeaux mixture is correct, the development of the bushes will not be retarded to the same extent.

Groundnut—Crown Rot. Experiments in Queensland are reported by R. B. Morwood on the control of "crown rot" which causes a rotting at ground level accompanied by wilting of the above-ground parts of the groundnut plant. Successful chemical seed treatment was obtained with 'Agrosan' GN at the rate of 1 oz. per 20 lb. of seed (var. "Virginia Bunch") and 1 oz. per 60 lb. of seed (var. "Red Spanish"). The inclusion of a 3 year grass ley (especially Rhodes grass) in the 10 year rotation period, and avoidance of injury to the kernels were also advocated. *Morwood, R. B.—Queensland Agric. J.*, 63, 1946.

Groundnut Seed Dressing. Experiments we have carried out in this country, in conjunction with Thomas Robinson and Son, Ltd., have shown that this company's seed dressing machine is eminently suitable for dressing groundnuts with 'Agrosan' GN. The optimum rate is probably in the region of 2 oz. per bushel (assuming 1 bushel equals 50 lb.) or slightly less. Output of the machine is 100—200 bushels per hour. The oily nature of groundnuts enables them to take up any normal rate of dressing without dustiness or accumulation of surplus waste in the bag of dressed nuts.

Tobacco—Damping off. Experience in India has proved the effectiveness of 'Perenox' in controlling "damping-off" in tobacco seed beds. The strength used was 2½ lb. per 50 gallons water, applied at 1 gallon per 16 x 4-ft. bed. It was found to be superior to Bordeaux mixture for this purpose.

Vegetable Seeds—Damping off. A 50% T.M.T.D. (tetramethyl thiuram disulphide) dust was found to be the most effective means of controlling "damping off" in vegetable seedlings. Treatment consisted of dusting the seeds before sowing. Spinach, cucumber, carrot, cabbage and tomato varieties were successfully treated in this way. Lettuce seeds were, however, injured by T.M.T.D. dust, and copper preparations are advised in this instance. *Taylor, C. I. and Rupert, J. A.—Phytopath*, 36, 1946.

Cabbage—Clubroot and Damping off. Tuads (tetramethyl thiuram disulphide) applied before seeding with complete fertilizer gave better control of clubroot than all other treatments including mercury salts, Fermate, Phygon and Dithane. The same treatment also controlled damping-off. *Doran, W. L.—Phytophathology* 37-848, 1947.

Soil Fumigation. In greenhouse tests of 13 fumigants, chloropicrin was found to be by far the most effective agent against *Fusarium* damping-off in peas. Ethylene dibromide was the best nematocide (followed by DD, methyl bromide and chloropicrin) but its use in the greenhouse is limited by long persistence of its phytotoxicity. *Stark, F. L. and Lear, B.—Phytopathology*, 37 : 698-711, 1947.

WEEDKILLERS AND HORMONE PRODUCTS

Weeds Susceptible to 'Agroxone.' The now rapidly extending use of hormone weedkillers such as 'Agroxone' has naturally stimulated inquiries from overseas sources as to which weeds can be controlled by its application at economic dosage rates. Reliable evidence can only be obtained through experiments carried out *under local conditions*. We wish to emphasize this latter point most strongly because it has been repeatedly found that a given dose which is successful in controlling a particular weed in one country may be quite ineffective against the same weed under different conditions. The list given below comprises the most susceptible overseas weed species—*i.e.*, those which, from reports so far received, can be controlled under a wide range of conditions by 1—2 gallons Liquid 'Agroxone' per acre. The stage when application is made would normally be pre-flowering and in the case of annual weeds best results are normally obtained on young seedlings. Liquid sprays have generally been found more effective than application of dusts, the latter giving notably variable results under dry conditions.

List of Susceptible Species

Beta spp.—Wild beet
Bidens pilosa—Railway daisy, Spanish needle
Brassica adpressa
B. arvensis—Field mustard.
B. campestris—Wild turnip
B. juncea—Indian mustard
B. sinapis—Charlock
B. Tournefortii
Chenopodium album—Lambs quarters, fat hen
Commelina longicaulis—Water grass, dayflower
C. benghalensis
Convolvulus arvensis—Bindweed (aerial portions)
Eichornia crassipes—Water hyacinth
Galinsoga ciliata

G. parviflora
Ipomoea purpurata—Annual morning glory
Medicago spp.—Trefoils
Plantago spp.—Plantains
Ranunculus arvensis—Field buttercup
R. *repens*—Creeping buttercup
Raphanus raphanistrum—Wild radish
Rapistrum rugosum—Wild turnip
Rumex spp.—Docks and sorrels (young stages)
Sisymbrium officinale—Hedge mustard
S. altissimum—Tumbling mustard
Thlaspi arvense—Penny cress
Amaranthus spp.—Pigweeds

This list makes no pretence to completeness. Our research staff are actively engaged in compiling the full data and when these are available they will be published. In particular it should be emphasised that there are many other weeds susceptible to 'Agroxone' either at higher dosage rates or at the minimum rate under circumscribed conditions.

Control of Nutgrass. Nutgrass—*Cyperus rotundus*—is a serious weed pest in many countries, chiefly in the tropical zone, and the search for an economic method of eradication has been given high priority. In the West Indies successful control has been obtained using 6 gallons per acre of 10% Liquid 'Agroxone' diluted with 24 gallons of water. Recently infested land may be cleared of nutgrass in 4 weeks by a single application, but where it has been long established 2 or even 3 applications will be necessary. Although grass-like in habit, nutgrass is a sedge (*Fam. Cyperaceae*). Rushes (*Fam. Juncaceae*) have also proved in this country to be susceptible to 'Agroxone' in spite of their close resemblance to the true grasses which are resistant.

Water Hyacinth Control. Small-scale experiments in both India and South Africa point the way to the large-scale use of 'Agroxone' in killing the water hyacinth (*Eichornia crassipes*) which chokes irrigation canals and other waterways.

In South Africa 1% 'Agroxone' dust was reported to give a complete kill, whilst in India ½, 1 or 2 cwts. applied to the leaves gave 90—100% control in 22 days.

Similarly the liquid 10% preparation at 20 c.c. per gallon of water was fully effective in South Africa, equally good results being obtained in India at strengths of 0.1—0.01% in 12—20 days after spraying. When applied to the water and not to the leaves the effect was less pronounced in Indian experiments, though South Africa report complete kill using 15 c.c. of the 10% liquid per 50 gallons of water.

No details of trials on a practical scale can yet be reported from the above countries, though these are in progress and Government action to sponsor control schemes is well under way.

Eradication of Bracken. The result of trials carried out in this country by Dr. W. A. Millard, late of the Ministry of Agriculture, shows that 'Atlacide' powder applied at 2 cwt. per acre gives a complete kill of current year's growth of bracken and that no further growth is made the following year. The extermination is permanent; this applies also to heather, but grasses are only slightly scorched and develop a good covering, sufficient for grazing, by the summer following application. 'Atlacide' is best applied when the fronds are three-quarters expanded, and scorching is most pronounced if they are moist enough for the powder to adhere. Both experimental sites consisted of rough, heather moor at over 1,000-ft. altitude.

Precautions in the Use of 2,4-D. Field observations and laboratory tests point the need for special caution in the use of 2,4-D weedkillers, especially the esters, apart from the danger of drift to neighbouring crops. Toxic residues of both ethyl and butyl esters remained behind in metal sprayers after successive washings with hot water and soap, and with strong alkali. Two washings with acetone removed most of both esters. In the case of the sodium salt of 2,4-D three washings in tap water were sufficient to remove all toxic residues. Volatile products from the esters may also remain behind in equipment and containers and it is doubtful if power equipment could be rendered sufficiently safe for other uses. No toxic volatile products could be detected after spraying with the sodium salt. *Johnson, E. M.—Phytopathology*, 37, 367-369. 1947,

2,4-D—Persistence in Soil. The persistence of 2,4-D in various soil mixtures was tested by observations on the growth of red kidney bean, mustard, African marigold and barley. After four weeks cropping in a greenhouse all traces of 2,4-D toxicity had disappeared except in limed soils and those treated with 2,4-D at the highest dosage of 200 p.p.m. Caution in the use of 2,4-D on calcareous soils is indicated. The addition of organic matter in the form of leaf mould strikingly reduced 2,4-D persistence in limed soils. *Kries, Olive H.—Bot. Gazette*, 108, 4, 1947.

Premature Fruit Drop. Experiments carried out at a number of centres in Palestine under varying conditions during the 1945 and 1946 seasons revealed that 'Phyomone' (alpha-naphthyl acetic acid) used at a strength of 10 p.p.m. had an appreciable effect on most standard apple varieties with one application at the end of the first week in August. More clear-cut effects were registered in irrigated orchards than in non-irrigated areas, and in cases where abnormal disturbances occurred, such as heavy leaf-fall due to pest attack, the influence of the hormone on fruit drop was only slight. In all experiments 'Phyomone' was sprayed in combination with lead-arsenate. Quantities applied are not recorded. *Gratsh, H. and Brotsky, D.—"Hassader," xxii*, 9, 1947.

PUBLICATIONS

It is proposed in this section of the Review to keep our overseas friends informed of all technical leaflets, brochures or other publications which we issue for use in overseas countries. In this first number we give the full list of publications available at the present moment and in subsequent numbers we will notify our readers only of new issues as they appear, with brief notes on the ground which they cover.

SALES LITERATURE

IT is our endeavour to keep overseas companies and agents fully supplied with all the literature necessary for sales purposes. Separate leaflets are at present issued only for the more important products, but with new issues in preparation we hope in the near future to provide publicity matter covering the greater part of our sales range. It will, we hope, be appreciated that the very difficult paper supply position in this country is seriously limiting our output of printed matter and frequently delays the publication of urgent technical information.

In order to widen the scope of our publicity campaign we fully realise the importance of issuing our leaflets in a number of languages. French and Spanish editions are already available of a few of our publications, but arrangements are now nearly completed whereby all publicity matter will be translated into French, Spanish and Portuguese and will thus find a considerably extended circulation. Individual booklets or pamphlets are in special cases translated into other languages besides those above-mentioned, and we are always glad to assist overseas countries in the production of their own literature by supplying illustrations, checking script and in other ways.

'PLANT PROTECTION' PAMPHLETS AND LEAFLETS NOW AVAILABLE

Ref. No.	*Title*	*Products described*	*Languages*
207/347	Hortomone A	Hortomone A	English
38/547	Derris Insecticides	Abol Insecticide Derrisine Katakilla Polvosol Drymac No. 2 Derrimac	English
38/547	Winter Washes	Ovicide Spraymac Capsine	English
43/647	Spersul Dispersible Sulphur	Spersul	English
—	Agrosan GN Nomersan	Agrosan GN Nomersan	English
—	Perenox and Perelan 1	Perenox Perelan 1	English French Spanish
—	Control of Weeds in Cereals by Agroxone Selective Weedkiller	Agroxone Dust	English
42/647	Liquid Agroxone	Agroxone (Liquid)	English
—	Cymag	Cymag	English
	The Agrocide Products containing 'Gammexane' (superseded by 35/547)	Agrocide 1 Agrocide 2 Agrocide 3 Agrocide 7 Agrocide Wettable Powder Liquid Agrocide 3	English French Spanish
37/547	Agral Wetters and Spreaders	Agral Liquid Wetter Agral 2	English
35/547	The Agrocide Range of Insecticides	Agrocide 1 Agrocide 2 Agrocide 3 Agrocide 7 Liquid Agrocide 3 Agrocide Wettable Powder	English
32/447	Products for Export	All products on the Export sales range	English French Spanish
—	Science in the Service of Agriculture	The part played by Plant Protection Ltd.	English

PRODUCT REFERENCE SUMMARIES

In addition to the general literature detailed above, plans are under way to prepare printed summaries giving all the available technical information on each of our products in a form suitable for easy reference and for the inclusion of supplementary data as it becomes available. These summaries will primarily be for the use of our associated companies and agents, but they may also be circulated to selected research workers and institutions who are co-operating with us for purposes of scientific research. Our Export Catalogue may also be included in this category since in its new form, to be issued this year, it will comprise information on all P.P. products under headings and will be bound in loose-leaf form so that periodical amendments may easily be made.

FILMS

The list of films which we give below includes those which are now available and for which copies may be ordered from us by our overseas representatives. The P.P. film unit is continually at work making new films, and as further titles become available they will be noted in this column.

All films are on 16 mm. Kodachrome stock, and with each one we send an annotated list of sub-titles (captions) and descriptive notes for the benefit of those intending to project them.

Already considerable numbers of copies of these films have been sent abroad and we have received ample evidence of the valuable use to which they are being put. One striking instance of this has been sent to us by our representatives in Turkey where a film tour of the important agricultural district of Izmir was recently made, showing the two ' Gammexane ' films on the control of wireworms and flea-beetle. At each centre large audiences of farmers attended the shows, listened to talks on plant protection matters and received pamphlets explaining the uses of our products. But the highlight of the tour was at Manisa where no less than 5,000 people flocked to the show which of necessity was held in the open.

List of 16 mm. Colour Films

Development of ' Gammexane ' in Control of Flea Beetle
Control of Wireworms
Control of Seed-borne Diseases
Control of Weeds in Corn
Colorado Beetle
Science and the Farmer
Intensive Vegetable Production for Market

OTHER LITERATURE

A limited number of copies is available of the following papers, read at the congress of European and North African agents held at Fernhurst Research Station in June last year :—

' The Agrocides ' with special reference to Soil Insecticides and Taint, by Mr. B. A. R. Gater (Fernhurst).

Insecticide Problems in Finland, including the Local Application of the ' Agrocides ', by Mr. Talvitie (Soren Berner, Finland).

The application of present knowledge to the control of weeds in grassland and cultivated turf with products containing ' Methoxone ' and related chemicals, by Mr. L. R. Reed (Fernhurst).

Experiences with ' Agroxone ' in France, by Mr. J. A. Planiere (Fayol Gilbert et Cie, France).

Fungicides with Special Reference to ' Perenox,' ' Spersul ' and ' Tulisan ' by Mr. I. M. Burnet (Fernhurst).

Competitive Products, by Dr. E. Holmes.

The development of Selective Weedkillers at Jealotts Hill, Mr. H. L. Burgess (Jealotts Hill, Overseas Section).

Fundamental Aspects of ' Gammexane ' (as incorporated in the ' Agrocides ') by Mr. F. J. D. Thomas (Hawthorndale, Entomological Section).

"THE FARMER & STOCKBREEDER"

This leading British agricultural weekly is extending its overseas circulation and will gladly supply a specimen copy to readers of Plant Protection Overseas Review who write to The Advertising Manager, The Farmer & Stockbreeder, Dorset House, Stamford Street, London, S. E. 1.

GLOSSARY

'GAMMEXANE' is the registered trade mark of the I.C.I. brand of the gamma isomer of hexachlorocyclohexane or gamma benzene hexachloride (gamma BHC for short). Early in the development of products containing this chemical, Plant Protection Ltd. based their agricultural insecticides on benzene hexachloride (BHC) itself, but with increased knowledge it is becoming possible to specify them in terms of gamma BHC—the active isomer.

In the light of the above, readers of this Review may care to have information on our 'Agrocide' products summarized as follows :—

	% BHC	% gamma BHC
'Agrocide' 1	2	0.25
'Agrocide' 2	3.5	0.45
'Agrocide' 3	5	0.65
'Agrocide' 7	20	2.60
'Agrocide' Wettable Powder ...	50	6.50
Liquid 'Agrocide' 3	—	3.00

In addition to the above, the following formulations have been marketed on a limited scale, for specific purposes, in certain overseas territories :—

	% BHC	% gamma BHC
'Agrocide' 5	10	1.30
'Agrocide' 10	50	6.50

'METHOXONE' is the registered trade mark of the I.C.I. brand of sodium 2.methyl 4.chloro-phenoxy-acetate and is the active principle of Plant Protection's hormone selective weedkillers.

The following data will be of assistance in considering relevant articles in this Review :—

	% "Methoxone"
'Agroxone' Dust	1
'Agroxone' Dust concentrate	5
Liquid 'Agroxone'...	10

NOTES ON CONTRIBUTORS

O. B. LEAN, B.SC., D.I.C. Born in 1901, Mr. Lean was educated at the University of Manchester, where he specialised in Zoology. After studying entomology at the Imperial College, London, he was appointed Government Entomologist in Nigeria, where his work was mainly concerned with insect pests of cotton. Since 1930 Mr. Lean has made a special study of locusts and was responsible for defining the outbreak areas of the African Migratory Locust in the French Sudan. In 1932 he joined the staff of Imperial Chemical Industries Limited, later becoming the first Head of Hawthorndale Laboratories. In 1942 Mr. Lean was seconded to the British Government for locust control work in the Middle East, serving two years in Iran before becoming Chief Locust Officer of the Middle East Anti-Locust Unit in Cairo. His experience in locust work has been gained in some 25 countries of the Middle East, Africa and the Americas.

YRJO K. K. TALVITIE, M.AGRIC. After qualifying in 1943 at the University of Helsinki, Mr. Talvitie served first as an Assistant, later as Plant Protection Inspector at the Agricultural Experiment Station. In 1946 he was appointed Technical Manager of Soren Berner & Co. and now holds the post of Manager of their Plant Protection Department. In addition to a number of papers on pest control problems, Mr. Talvitie is the author of " Jokamiehen Kasvinsuojeluopas" 1947 (Everyman's Plant Protection Guide) and is editor-in-chief of Plant Protection News, the only publication of its kind in Finland.

N. WRIGHT, B.SC., A.R.C.S., A.I.C.T.A. At the Imperial College (Royal College of Science), London, Mr. Wright qualified in Botany and then continued his studies under a Colonial Agricultural Scholarship at Cambridge and Trinidad. In 1932 he was appointed Lecturer in Botany at the Imperial College of Tropical Agriculture, Trinidad, where in addition to his teaching duties he specialised in the citrus crops and studied agricultural methods in the neighbouring Caribbean countries. From 1937 till the outbreak of war in the Far East, Mr. Wright was Research Botanist at the Rubber Research Institute, Malaya, where he was principally concerned with Field Trials and general advisory work on estates. In 1947 he joined the staff of Plant Protection Limited and is now in charge of Technical Publicity for their Export Department.

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